

The art and science of ice: Edward Adrian Wilson's ice crystal drawings

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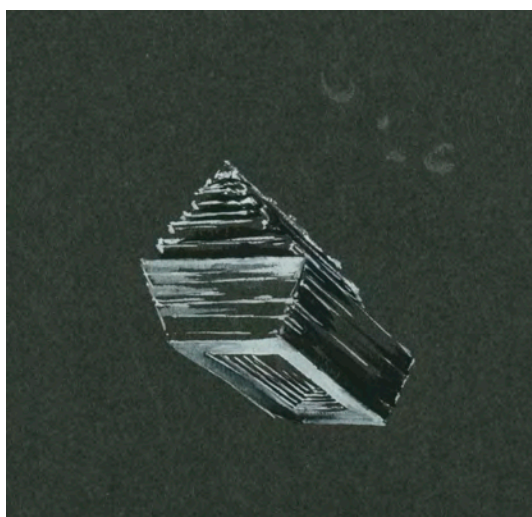


Figure 1. Wilson, E. A. Detail of Untitled, chalk and ink sketch of ice crystals, 1901-03.

A century ago, in that tragic, Antarctic tent of 1912, one of the three dead men had been Chief Scientific Officer for the *Terra Nova* expedition and also, an artist.¹ Edward A. Wilson (1872 - 1912) may need little introduction for some and his esteemed character, biography and the expeditions he undertook – whether the ‘winter journey’ to collect emperor penguin eggs, subject of one of the greatest works of Antarctic writing, or that final journey to the South Pole – are well documented from a variety of perspectives. Wilson’s own journals have been published in several editions and many publications have included reproductions of his watercolours or drawings. Yet there is little critical evaluation of his prolific artistic output independent of these wider expedition histories and, rather surprisingly, no monograph on his work either in parts or in whole, with the exception of a 1967 book on Antarctic birds.² The enormity of this gap and the possible reasons for it cannot be addressed in a short research project³, but a critical study of specific works seems useful. This research therefore examines a small set of drawings that have received little attention: his ice crystal studies. How these drawings relate to the knowledge of the day and how they may relate to discussions about science and art – as both were defined in Wilson’s own time, and today – are further concerns in this essay. Both of these contexts will in turn contribute to a reconceptualization of Wilson’s artistic output.

The drawings are of hoar crystals, a particular type of ice or frost produced by the process of deposition and usually found in caves, crevasses or on material structures such as buildings.⁴ The drawings for this study are collected in two of three lightly bound, contemporary volumes held in the collections of the Scott Polar Research Institute (SPRI) in the University of Cambridge, UK.⁵ They consist of three chalk and ink drawings on dark grey paper, showing several discrete crystals on each page (only one of the three is shown here, as Fig. 3), and two pencil drawings on white paper, both done from life. The set of drawings on dark paper is probably derived from the one of the pencil drawings, titled after Wilson’s annotation at the top of the page ‘Large crystals deposited on the inner walls of the deck houses on board ship, about 3 or 4 x life size’ (Fig 2). These drawings are undated but are believed to be from the *Discovery* expedition, 1901-04.⁶ The remaining pencil drawing, however, titled ‘Ice crystals, from caves in the glacier of South Bay, Cape Evans, McMurdo Sound’ is dated April 28, 1911 so is from the *Terra Nova* expedition (Fig 6). There is a considerable gap, therefore, between the earlier studies and the 1911 drawing, which has some bearing on the following discussion.

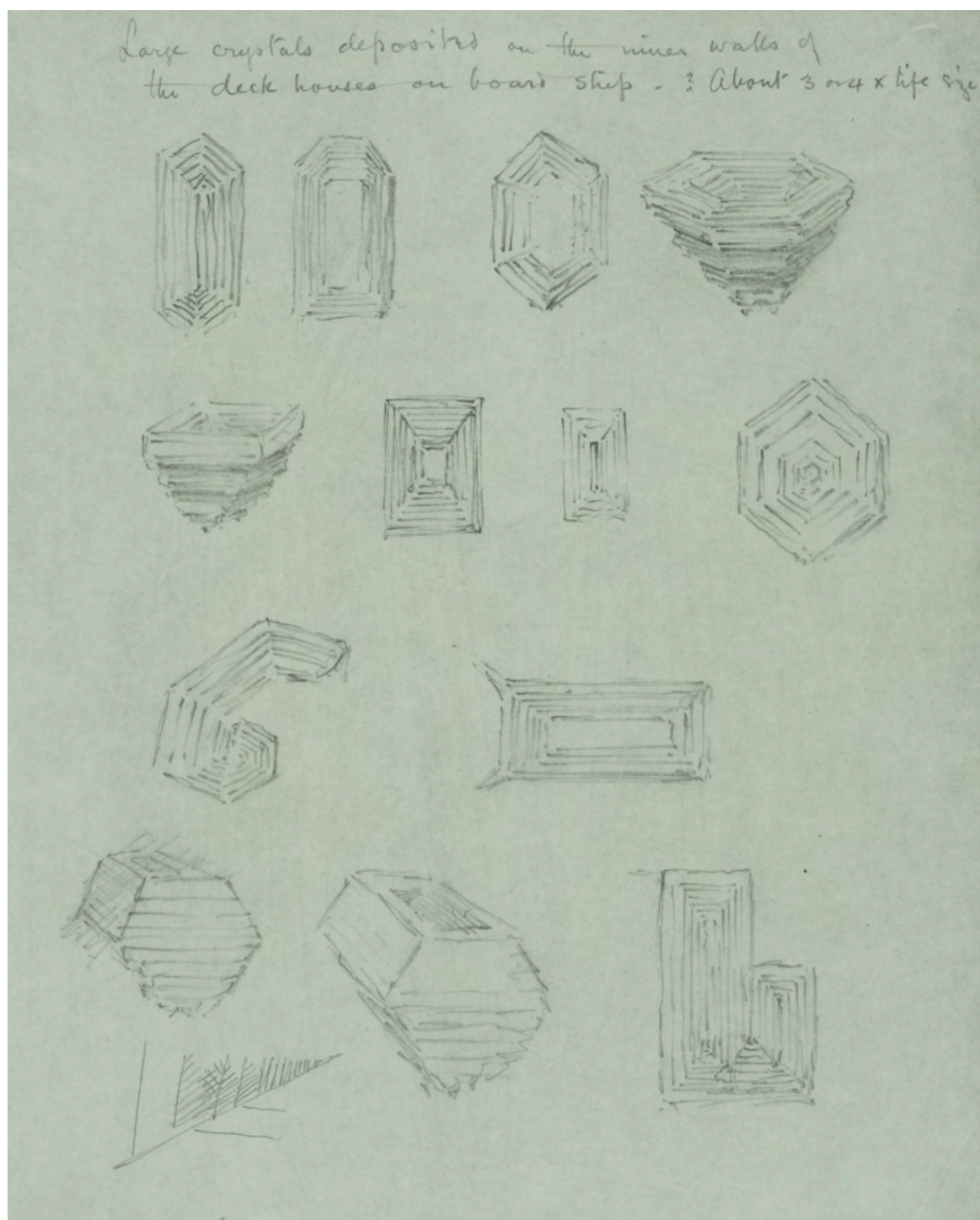


Figure 2. Wilson, E. A. 'Large crystals deposited on the inner walls of the deck houses on board ship, about 3 or 4 x life size'. SPRI Accession number: N: 1801/58. 1901-03.
Reproduced with the permission of the Scott Polar Research Institute.

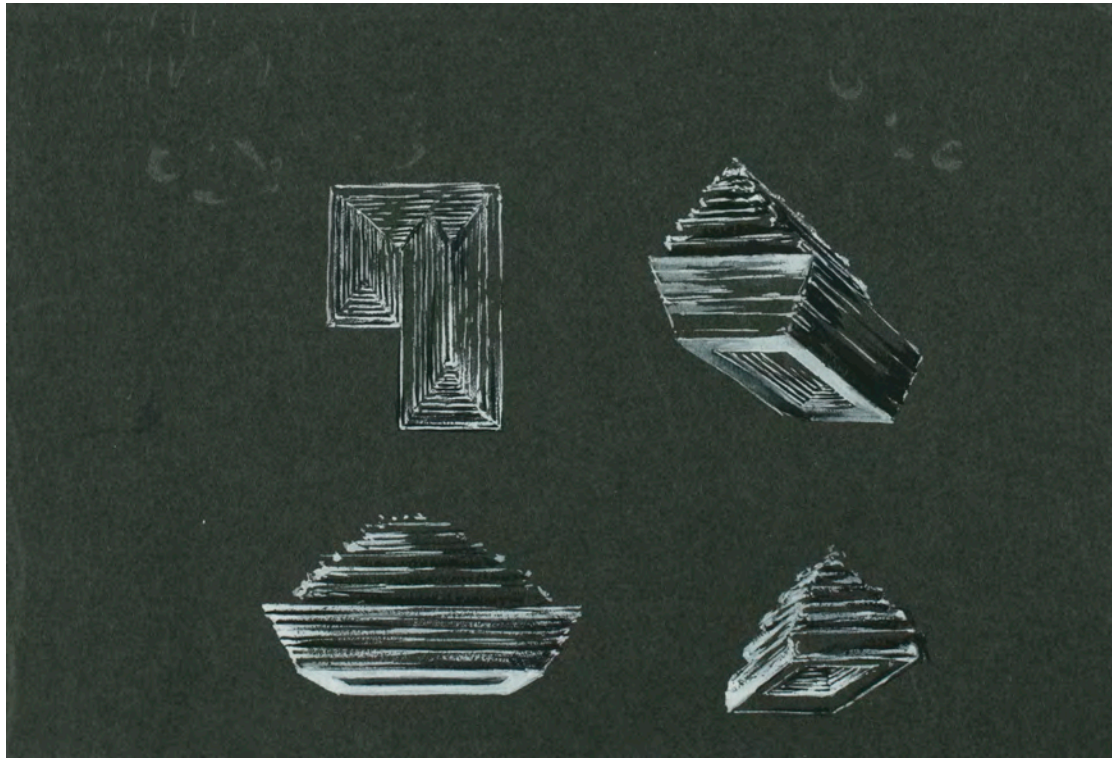


Figure 3. Wilson, E. A. Untitled, chalk and ink sketch of crystals. SPRI Accession number: 1803/149. 1901-03. Reproduced with the permission of the Scott Polar Research Institute.

Wilson did not regularly comment upon ice crystals in his diaries, unless he felt them to be particularly worthy of note. During the 1902 southern journey with Scott and Shackleton, his diary entry notes “The prismatic colours of the ice crystals were wonderful too today, forming what looked literally like a carpet of snow, glittering with gems of every conceivable colour, crimson, blue, violet, yellow, green and orange, and of a brilliance that would put any jewel in the shade.”⁷ Earlier on that journey he had written “Surface inches deep with snow crystals, beautiful feathery six limbed stars of considerable size, just the things one sees done in white on a black background in text books.”⁸ This second comment lets us know that Wilson was aware of a norm for educational representation, so the drawings done on near-black paper could be thought to follow this convention. If it is the case that the drawings on dark backgrounds were based upon the deckhouses sketch, Wilson has made several significant transformations: the selection and isolation of the crystals, the arrangement on the page, and a focus on structure. Figure 3 shows four of the crystals from the deck house crystal drawing, some rotated to display what, to Wilson, were their most pertinent features; for example, the hollowness of the crystals at the top and bottom right, and the shape of the crystal on the top left. Although the drawings are described as being of chalk, they may have been augmented by black ink to help accentuate

the forms.⁹ With the exception of the crystal top left, the overall impression of this drawing is the three-dimensionality of the crystals, appearing to project from the page to reinforce the forms Wilson had seen.

The acts of selection and isolation constitute a focussing device for Wilson. Some of this is derived from the textbook display convention, and also from his use of the conventions for bird studies (several isolated parts arranged upon a single page, itself a topic beyond the scope of this paper.¹⁰) What is not present is also important: these *Discovery*-period drawings do not focus on the often astounding arrangements such crystals form when growing from structures, or the beautiful appearance of snowflakes, all of which may easily have been present inside the deck houses. Wilson chose to focus on the form of the crystals. That he was concerned with the structure of ice crystals is likely related to the lack of knowledge about the properties of ice at this time, of which more below; these drawings are not simple illustrations of the already known, but instead ask questions about why and how ice forms in the ways it does. The way the individual forms appear to loom out from the page enhances this sense of questioning. The drawings also demonstrate that Wilson thought hoarfrost was worthy of consideration; his version near monumentalises them. The drawings are therefore interpretable as a form of thinking on paper, not recording or illustrating – those processes would have produced quite different results, and we know Wilson was easily capable of those approaches. These studies seem much more raw, less polished than his bird studies; I propose this correlates directly with the lack of knowledge about the properties of ice, of what was being explored. Wilson's approach combines observation with focussed analysis and, by contrast with his zoological studies, does not lead to confident conclusions. These drawings leave questions hanging in mid-air, like the ice crystals themselves.

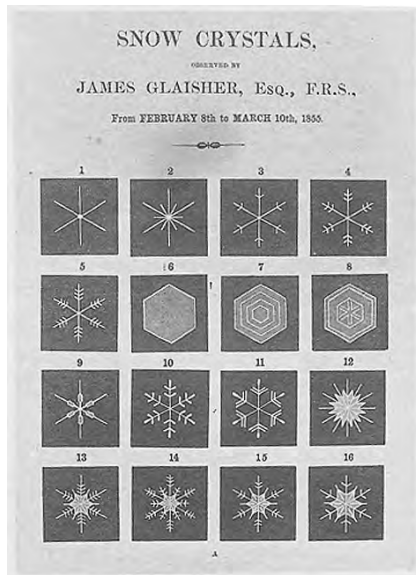


Figure 4. Hoar crystals in small crevasse exposed to view, near Turtle Island (off the coast of Ross Island), Antarctica, December 2012. Photograph courtesy of Dr. Brian Stewart.

At the time of the *Discovery* expedition, ice was regularly discussed in major journals such as *Nature* or the *Physical Review*, even if these

studies are not necessarily ice physics or morphology as known today.¹¹ The interest in ice in part reflected contemporary geology's concerns with glaciers, as they raised issues about the movement of rocks and patterns of geomorphology that were not well understood. In the 18th and 19th century, geology was also fuelled by concerns about the early history of mankind; an issue that would remain contested for decades thereafter. Early 19th century glaciologists such as Jean de Charpentier, Louis Agassiz and others had established the existence of (and Agassiz coined the term for) the Ice Age and, by the late 19th century, evidence for variation in the extent of glaciation had largely been accepted. Scottish geologist James Geikie, who we know Wilson was reading during the *Discovery* years¹², noted "The time will come when geologists will endeavour to correlate the drift deposits of the northern with those which are known to occur in the southern hemisphere. At present, we are insufficiently acquainted with the latter."¹³ Glaciology necessarily developed in tandem with knowledge of the physics of ice. Although humankind has encountered ice crystals in myriad forms for millennia, the recognition of ice physics fundamentals could not be described as fully established until the mid-twentieth century.¹⁴ Although the relationship of temperature to ice crystal shapes had been established in 1853, other, related properties remained to be explored.¹⁵ For example, salinity in relationship to water's freezing point was not understood until 1887¹⁶, the physics of melting required Einstein's explanation of the low temperature heats of solids as then applied to ice studies in 1910¹⁷ and, although Ostwald's step rule (1897) was a key to understanding nucleation (and therefore understanding crystallization processes including deposition), that theory is still being refined today¹⁸. At the time of the *Discovery* expedition, one could say that the conditions under which hoar crystals develop had been established, but not how they grow, or why they grow the shapes they do.

Western art history has not greatly furnished us with ice or snow studies¹⁹ and the nearest models may perhaps be the published illustrations of Cecilia Glaisher, done for her husband's meteorological studies of 1855.²⁰ Microphotography of ice crystals had begun in Germany with Flögel in the late 1870s, but flourished with the work of American photographer Wilson Bentley.²¹ Bentley's work may have been known in Europe, through publications with wide distributions such as Harpers Magazine. Meteorologist Gustav Hellman published a study of ice crystals in 1893, which included photogravures of microphotographs.²² Both Hellman and Bentley, however, over-represent symmetrical examples, when asymmetry occurs more frequently in nature. Mrs. Glaisher's studies also



seem to suffer from this tendency, whereas Wilson's ice crystal drawings do not suffer from this 'tidying up' of natural phenomena. A key difference is that most of these other visual studies are concerned with issues of ice crystal classification, not one of Wilson's concerns.

Figure 5, Cover image from James Glaisher's printed sheet of Snow Crystals, with drawings by Cecilia Glaisher, 1855.

Captain Scott discussed ice flowers in some detail, after an Easter 1902 event that inspired taking measurements of the salinity of sea ice at different depths exploring "why the ice flowers should differ in form in various places" and their relation to salt saturation.²³ Notably, the discussion preceding the investigation was one of wonder: "This is a season of flowers, and behold! They have sprung up around us as if by magic: very beautiful ice flowers, waxen white in the shadow, but radiant with prismatic colours where the sunrays light on their delicate petals"; Scott also wrote that he found the subject of their state and formation "fascinating".²⁴ In August that same year Scott wrote about the sound an exhalation makes in extremely low temperatures; this passage is flanked by two pages of poetic descriptions of the surrounding landscape in the moonlit night, and in mist. In September he and others were excited by the thick and unusual coating of ice crystals formed around the ropes and nets lying underwater; stating he did not know of other accounts of phenomena of that type, or how they were formed. In winter 1911, during the *Terra Nova* expedition, the young Canadian physicist Charles Wright gave an evening lecture titled "Ice problems", Scott noting in his journals he was "instructive" on the subject of ice formations at differing temperatures and conditions, but was not clear on the subject of the freezing of salt water.²⁵ The ensuing discussion was rich and engaged enough to encourage Wright to devote more time to the subject. (One wonders what Wilson's input to the discussion was, having made his 1911 ice crystal drawing only a few weeks beforehand.)²⁶ These glimpses into the discussions around ice crystals during the expeditions do seem to reflect the state of knowledge of the day, but are also notable for the wider contexts within which they occur – Scott demonstrably shared Wilson's wonder for nature.

A case is not being made that these ice crystal sketches contributed to the knowledge of nucleation or other transformative material processes in their time.²⁷ They indicate to us, however, what Wilson chose to think about in a time when relatively little was known about the properties of ice, a substance that was already understood to be a key to the understanding of past climates. Had the drawings been better known in their time, they could have alerted others to the topic of ice physics. The drawings also would have represented a distinctly different approach for most naturalist art, away from the usual subjects of mountains, trees, cloud studies or more pastoral scenes. Interestingly, these drawings also move away from methods that aim for verisimilitude, despite claims often made for Wilson's art; even as recently as 1996 an important commentator was quoting an earlier appraisal of Wilson's art as being as "precise as photography".²⁸ Yet we have seen how artificial these drawings are, with their strong selectivity, the isolation of the item from its natural context and the focus on a specific feature, such as structure. The ice crystal drawings also do not fit the model of art contributing to science as a form of record-taking, augmenting actual specimens and sent collectively to a museum for further study, as has been claimed for some of his bird, fish or pathology images.²⁹ These drawings are not art in the service of science, illustrating or publicizing their explorations – a trope still reinforced today³⁰ – but seem to float freely, as evidence of Wilson's intelligent, questioning eye.

The problem with the model of art in the service of science is that it reduces art to a form of illustration. Such a model also denies that art has the ability to generate new knowledge, using its own forms and methods.³¹ The proposal above for Wilson's drawings as a form of thinking on paper is also rather too neat, as what he was thinking and actually doing remains moot. To better understand Wilson's ice crystal drawings, the status and purpose of art in his time must be considered, as well as Wilson's own relationship to art. Also, in the early years of the twentieth century, ice – and polar ice in particular – bore a weight of European symbolism, some of it religious, centuries in the making. These associations cannot necessarily be ignored, but without access to original manuscripts cannot here be fully explored.³² Wilson was a Christian who found no contradiction between his science with his faith, so the role of his faith will be examined below.

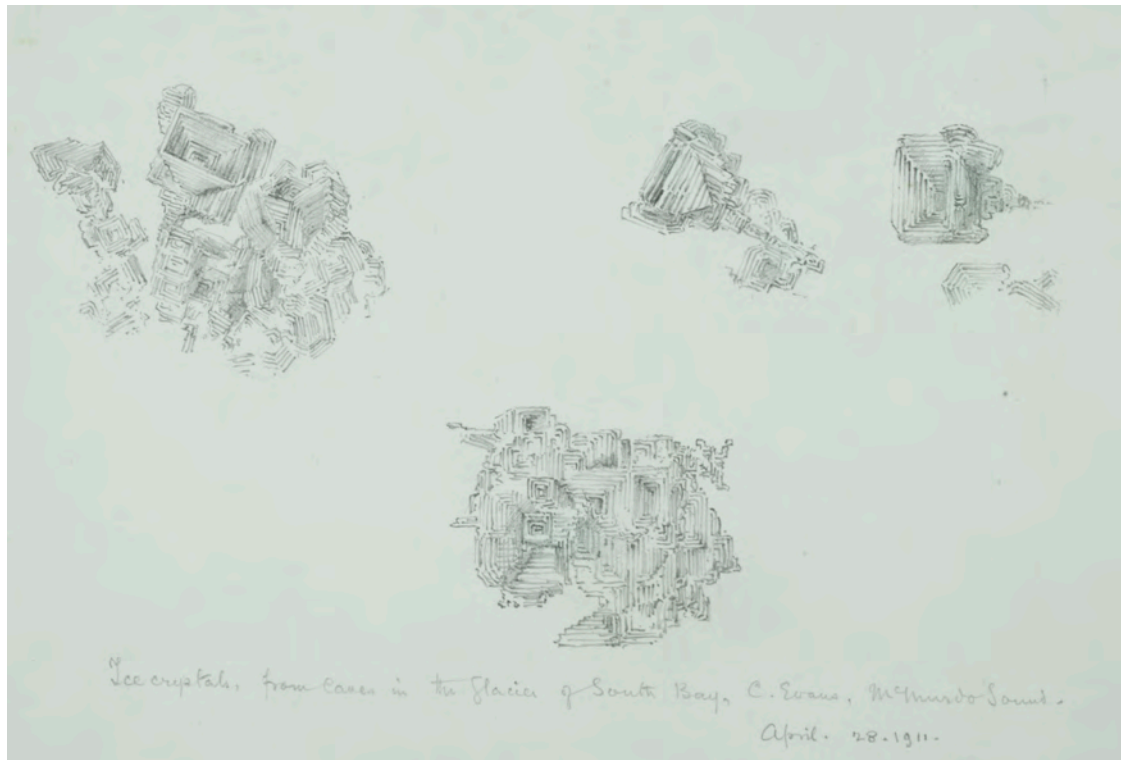
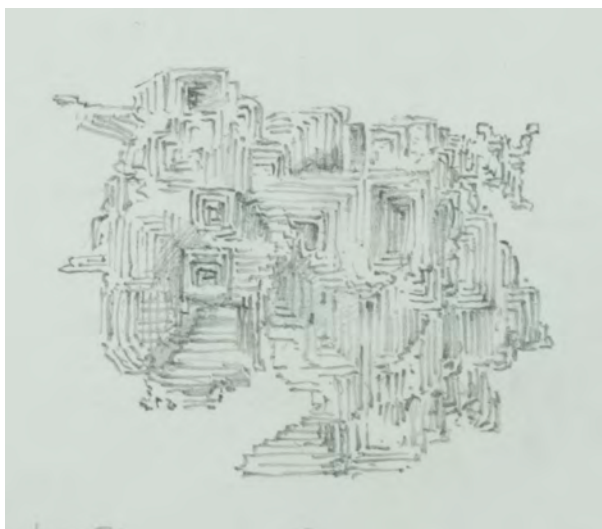


Figure 6. Wilson, E.A. Ice crystals from caves in the glacier of South Bay, Cape Evans, McMurdo Sound. 28 April 1911. SPRI Accession number: 1801/61. Reproduced with the permission of the Scott Polar Research Institute.

The drawing above, Figure 6, is dated April 28, 1911 and was therefore made during Scott's second, *Terra Nova* expedition, when Wilson was Chief Scientific Officer. Unlike Figure 2, this drawing is likely to be complete, not a form of note-taking for later, finished studies.³³ It was winter and Wilson had arrived at Cape Evans only on April 21st in the wake of the depot-laying journey to the Barrier, begun in January. That trip had been replete with blizzards and hardships, ending in an enforced, 6-week sojourn at the old Discovery hut at Hut Point, not known for its comfort. Return to the much more homely environment at Cape Evans must have been a great relief, if not a pleasure. A week after his return, back to work on the *South Polar Times* and other duties, Wilson was in an ice cave of the Erebus Glacier Tongue, drawing these crystals.³⁴

Unlike the earlier studies, much more of the surrounding crystal is rendered, although the study shows in the top right some discrete crystals similar to those drawn a decade earlier. In the 1911 drawing Wilson's focus is on the complexity of the structure, rather than just the forms themselves, as well as showing how parts of the crystals interrelate. The pencil marks are patient and confident, demonstrating ease in representing form and structure, although some parts of the drawing appear slightly less considered than others, arguably due to the cold conditions. It is unlikely that only four such crystal

structures were found inside the cave, so in this drawing one can discern how the parts stand in for the whole³⁵ (which is not the case with his bird drawings). Consequently, a focus



on complexity for these small sections has wider implications for the icy cave environment with which Wilson had been confronted. If the earlier, *Discovery*-period drawings are indeed a form of questioning, asking how and why, this 1911 drawing seems more accepting of what is present, engaging with, and marvelling at, the ice and its structures on its own terms.

Figure 7. Wilson, E. A. Detail of Figure 6.

Wilson's understanding of the act of observation needs some investigation. A contrast with recent times is useful to understand the difference in approaches: in the late twentieth century, the act of looking was regarded largely in terms of power, particularly concerning but not limited to gender relations. This was not the case in Wilson's time, when the act of observation was considered from a moral point of view – the modesty of downcast eyes, for example – or of a high moral order when connected to the contemplation of nature. As a self-taught artist with a strong identity as a naturalist, Wilson needed strong models, both theoretical and artistic. English art critic and theorist John Ruskin, an influence from early days, believed in the moral power of art and of its ability – if not duty – to reveal and discuss 'vital truths'.³⁶ "There is no moral vice, no moral virtue, which has not its precise prototype in the art of painting; so that you may at your will illustrate the moral habit by the art, or the art by the moral habit."³⁷ Ruskin is a complex theorist; when he writes about 'truthful' rendition, he means to indicate an attention to fundamental features; lines or formations that can tell the overall story or trajectory of an object or event. This is 'fidelity' as a form of interpretation, not the creation of illusionism. Ruskin had high ideals for art, well beyond reproduction: "But what we want art to do for us is to stay the fleeting, and to enlighten what is incomprehensible, to incorporate the things that have no measure, and immortalise the things that have no duration".³⁸ A 'truthful' observation of nature as a pathway to understanding God was a notion also held by other figures admired by Wilson, particularly poet and social reformer Alfred Lord Tennyson.

Tennyson's eponymous 1869 poem "Flower in the crannied wall,... But if I could understand/What you are, root and all, and all in all,/I should know what God and man is" well expresses the kind of philosophy Wilson espoused.³⁹

Lest there be any doubt of the intensity of Wilson's relationship to drawing, in 1899 he had written to his then fiancée, Oriana Souper, "Really I know of nothing that I have ever tried to do which has such an absorbing interest for me as drawing. I feel that if I deliberately hid it away and forced myself to take to doctoring, I might be in the same position as the man who had one talent given him and decided he better not use it."⁴⁰ Wilson had drawn from an early age, but an event that draws attention to how – and perhaps why – he chose to use his talents occurred in 1894 when he was 22 years old. After the death of a beloved youngest sister, he drew her on her deathbed. This drawing still exists, as it was a treasured possession for the family.⁴¹ It is easy to say that this act was a mere substitute for photography, but that would seem unlikely when post-mortem photography was a well-established industry at that time (even at its peak in the late nineteenth century). This drawing may represent the family's desire for a more intimate, loving approach to the subject, than that gained by inviting a professional photographer into the house. This demonstration of maturity and self-control may indicate a kind of asceticism in the ability to focus on the task. Clearly an act of reverence and respect, drawing for Wilson may have been a means to greater understanding.

Much has been written about Wilson's relationship to his Christianity, as it formed an integral part of his character and behaviour.⁴² Although contemporary authors focus on his asceticism and individual approach, some observation of convention was not outside his mien. Wilson's *Discovery* diary assiduously notes each religious calendar date at the outset of a day's entry, for example, on Sunday 2nd November 1902: "Twenty third Sunday after Trinity. At last we started, though it was a cold and windy day."⁴³ For Wilson, scientific exploration was, similar to his observing and drawing, a means of discovery and understanding. This in turn increased his longstanding love of nature; "Heaven is with us here, not in the skies to be reached only after death..."⁴⁴ Not all of Wilson's beliefs would be acceptable to all scientists of faith today, as he thought evolution would end when people attained a Christ-like state.⁴⁵ In the *Discovery* years he read John Fiske's 1899 book *Through Nature to God*,⁴⁶ and this title, like the Tennyson poem, sums up Wilson's approach. In one of his unpublished diaries he wrote "...I cannot bring myself to go to church, when the whole

creation calls me to worship God in such infinitely more beautiful and inspiring light and colour and form and sound. [...] When I am with other people or in a bad temper, I don't feel this; but oh, the joy of getting away alone and getting Him to show you things."⁴⁷ We cannot, therefore, disconnect what Wilson saw from the spiritual understanding of what he was doing, by looking and by drawing. These drawings, and probably most of Wilson's work, are clearly not the 'precision of photography' in action.⁴⁸

Did Wilson's faith extend to beliefs in the symbolic associations for ice, and polar ice in particular? Centuries of European mythologising had inscribed notions of the hyperborean regions as exceptional, near-mystical places, and these attributes had been extended to the Antarctic.⁴⁹ The idea of the poles as 'entry points' of the earth (axis mundi) was strong even in the late Victorian and Edwardian eras, so the journeys south had an numinous quality added to geographical discovery. More relevant to a discussion of ice crystals, ice has often been considered as an agent of catastrophe associated with the end of days (itself a long-held notion in European culture, and may be active in the discourse around climate change). As far as I can discern, evidence for Wilson believing in these notions is not present, although a caveat about the 'status' of diary entries and letters must be made. After his death, his widow destroyed much if not most of their personal correspondence.⁵⁰ Also, Wilson's diaries are as notable for what is not told, as well as what is told. Nearly every other commentator of either expedition mentions that Wilson was confidant, advisor and mentor to many. Yet none of these conversations or events is recorded in his own writing, perhaps not surprising for a man whose sledge flag motto was *Res non verba* (deed not words). Speculation on this subject would, therefore, seem inconclusive at best and perhaps even futile, but given Wilson's deep-seated Christianity, needs to be considered more fully than is possible here.

By contrast with much naturalist art, which largely following predetermined subjects and approaches, Wilson's ice crystal drawings seem remarkably free of predetermined habits. As we look at his drawings we can see Wilson looking, marvelling and trying to understand ice crystals' forms and methods of growth. His drawings direct our attention to the subject and suggest the questions that need to be asked. This is a method without words (notably, in Wilson's work, the words are the notational device, not the drawing) and seems much more modern than we might expect from the earnest illustrator of bird parts.⁵¹ It might be argued that Wilson was a scientist who sketched in his spare time; but this

interpretation ignores his impulse to draw as well as his beliefs about art's function. In a 2007 book titled *Pars Findings on Ice*, contributions from architects, poets, physicists, geologists, composers, mathematicians, artists and others (for example, celebrity chef Ferran Adrià) were brought together "to demonstrate that the sciences and the arts are essentially creative processes."⁵² This method of linking disciplines may be too broad to be useful here, but if we can see Wilson as an independent, individual creative eye seeking new sources and information and questions, he certainly transcends norms for the traditional naturalist or expedition artist, common models for the reception of Wilson's art. To give an idea of the actual contributions, the book includes work by toxicologist Laurie Chan on Climate Change and Food Security in the Arctic, ornithologist Marcel Klaasen on Birds in Polar Conditions, artist Olafur Eliasson's 6 tonnes of Icelandic ice in a Berlin gallery, physicist John Finney on the molecular structure of ice, to biophysics, ice cream, cartoons and poetry.

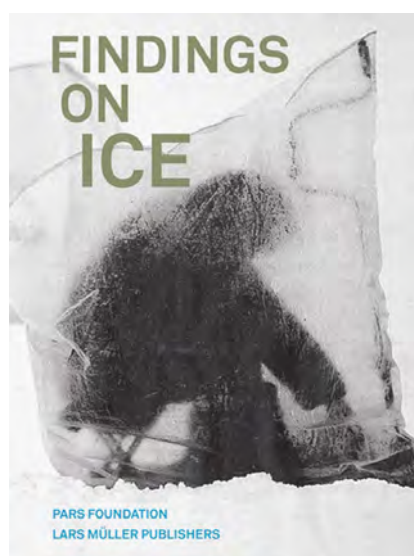


Figure 8, *Pars Findings on Ice*, cover image (man ice fishing in Kazakhstan).

Wilson's drawings would fit seamlessly into the *Pars Findings...* book; for different reasons, they seem contemporary: the group on the dark backgrounds for their questioning, the 1911 drawing for its marvelling at the complexity of nature. This investigative approach makes the drawings seem timeless; which is to say that this artistic position still resonates in our time. If these drawings were acts of scoping a topic, focussing attention, and choosing the questions to be asked, this art could be said to be as explorative as the expedition itself.

Conclusion

The few commentators of the art of Edward Wilson have proposed he was an expedition artist, a naturalist, and an accurate reproducer of nature. Along with historical issues surrounding the presentation of his work, these proposals have combined to limit the way in which his art has been received. Wilson was not a diligent illustrator of existing fact. Nor was he motivated by a desire to merely reproduce nature. Wilson's choice of subjects and his methods of representation represent a mind in search of greater understanding of nature and a need to engage more intimately with the spectacular sights he was privileged

to see (and knew he was privileged to see). Wilson drew because he had to; it was an interior impulse that would likely have flourished in any setting, and it was informed by his own brand of Christianity as well as Ruskinian tenets chiming with those beliefs. The freedom – and pressures – of working in Antarctica arguably liberated him from a strict adherence to convention, allowing a more direct, even personal, investigation of nature to take place: we can look at him looking. This is part of what makes these drawings seem quite contemporary. One of the tragedies of Wilson's early death was that it may have prevented more of this independent artistic development. Our understanding of his art was, and still is, shrouded by the tragic end of the 1912 expedition and his own near-immortalisation as one of 'Scott's men'. It remains to be seen if future studies can find reason to discuss Wilson's art for its method of focussing our attention onto a subject, and choosing what questions to ask about it, while remaining full of wonder: surely this can be art, as well as science.

Endnotes

¹ Back cover promotion for Williams (2008) describes Wilson as "the last major exploration artist."

² Roberts (1967). This large book includes four pages on the subject of Wilson as an artist; although useful, this account suffers by reducing art to aesthetics alone, pp. 30-33.

³ After one rebuff from a "pomaded" gallery assistant, Wilson did not again seek to exhibit his artistic work independently (Williams, 2008, p.60). The 1904 exhibition of the *Discovery* expedition at the Bruton Galleries in London – of which Wilson's work was only a part, being shown alongside sledge flags, photographs and more – likely set the tone for the reception of his work thereafter. Herbert Ponting noted that a plan for Wilson and he to co-exhibit after the polar journey was, after Wilson's death, rescinded by his widow in favour of an exhibition at the Alpine Club; Ponting (1921), p.185. While this late, lost opportunity is not being presented a sole determining factor in the absence of critical studies, it remains that if Wilson's work had been presented within more established art circles an examination of his subjects and the implications of his methods would have been a likely result and this study would not be so unusual.

⁴ Deposition is the process by which vapour is transformed, under particular sub-zero temperatures, directly into ice. A good account of hoar frost and depth hoar can be found in Hobbs (1974), pp. 569-571.

⁵ The drawings came to be in the SPRI directly from Wilson's widow, Oriana. There may be other crystal studies in the family archives in Cheltenham, but none are mentioned in Wilson (2000), or online catalogue of the Royal Geographical Society. There are also two, rock-like crystal drawings held at the SPRI, from the *Discovery* era, not discussed here.

⁶ Volume III of Wilson's notebooks at the SPRI are dated 1902-04 (personal communication, SPRI librarian, 28 January 2012).

⁷ Wilson (1966), p. 231. The entry is for Wednesday 31 December. Scott's use of a similar metaphor several days earlier (Dec 4, 1902) demonstrates his literary abilities: "As one plods along towards the midnight sun, one eye's naturally fall on the plain ahead, and one realises

that the simile of a gem-strewn carpet could never be more aptly employed than in describing the radiant path of the sun on the snowy surface. It sparkles with a myriad points of brilliant light, and is so realistic and near that it often seems one has but to stoop to pick up some glistening jewel." Scott (1929), p. 441.

⁸ Wilson (1966), p. 216. The diary entry is for Friday 21 November 1902, with ice crystals being noted for the previous few days.

⁹ At point of writing, I have not examined the original drawings at SPRI so all comments made here are based on digital reproductions.

¹⁰ See Martin Rudwick for a discussion of the rise of diagrammatic forms in geography (Rudwick, 1976) and more recently, James Elkins for his studies on the use of visual imagery for extra-artistic purposes (Elkins, 2001).

¹¹ From *Nature*, Grossmann and Lomas on "Hollow Pyramidal Ice Crystals" (1894) is but one example; there are articles and letters on subjects such as ice and brines (1887), ice caves (1900) and the formation of hail (1901); the *Physical Review* list includes Nichols on the Density of Ice (1898), a subject also broached by the Barnes in the same journal in 1901. This list is comprised only of titles relating directly to the matter of ice and its forms; articles and letters on Arctic and Antarctic sea temperatures, expeditions and more would likely broach these topics also.

¹² I am assuming Wilson was reading Geikie's second edition. In his diaries, Wilson notes that Sunday 24 and 30 August 1902 were both mostly spent reading Geikie (Wilson, 1966, p.177-178), as was the evening of Monday 15 September (p.188); on 17 August 1903 Wilson was showing Ferrar some rock formations similar to those illustrated in Geikie (p.283).

¹³ Unfortunately for his legacy, Geikie continued "But we shall hardly expect to meet in the south with such striking geological evidence for the former existence of a glacial period as our own hemisphere so abundantly presents." Geikie (1876), p. 485. He also noted that "At present, however, the glacial deposits of the south are not sufficiently known, and we cannot tell whether they contain any records of interglacial mild climates..." p.484.

¹⁴ An excellent overview of the history of the observation of snow crystals that includes Chinese and Japanese histories alongside European is recounted in Hobbs (1974). Further references can be found in Needham, J and Gwei-Djen, L. (1961).

¹⁵ Hobbs (1974), p.525, notes that Guettard (1762) and snowflake classifier Scoresby (1820) had suggested a relationship with temperature before it was established by K. Fritsch in 1853. At this point I cannot, however, discern if the establishment of temperature's contribution includes recognition of the role of humidity.

¹⁶ Scottish physical geographer John Young Buchanan was part of the scientific staff on the *Challenger* expedition to the Southern Ocean, 1872-76. His work "On Ice and Brines" was presented in 1887 to the Royal Society in Edinburgh and published in the *Proceedings of the Royal Society of Edinburgh*, vol 14, pp. 129-149. See also two articles of the same title in *Nature* (1887), vol 35, April. pp. 608-611, and vol 36, May, pp. 9-12.

¹⁷ Wettlaufer et al, (1999), p. 11-12. The authors note that this finding rested on two nineteenth century fundamentals including Planck's co-ordinates for "a critical point between ice and water" and van der Waals' 1873 theory of "the liquid-vapour critical point".

¹⁸ References for Ostwald's original article and a key challenge or proposed amendment by Stranski et al, in 1933, can be found in Kawasaki et al (2010).

¹⁹ There are of course paintings of mountainous scenery, but the depiction of nature at its most awesome would not have been aided by details of snow or ice crystals. Needham and Gwei-Djen (1961) note Asian examples, but these would not likely be known by Wilson and his colleagues.

²⁰ James Glaisher (1809-1903) was a Fellow of the Royal Astronomical Society as well as an important meteorologist. His articles on snowflakes (with his sketches being reworked by his

wife for publication) include “On snow crystals in 1855” and “On the severe winter at the beginning of 1855, and on snow and snow crystals” published in the *Quarterly Journal of Microscopical Science* and the *Council of the British Meteorological Society*, respectively; see Hunt (1996), pp. 323-325. The online catalogue of the Fitzwilliam Museum in Cambridge, UK records holdings of, presumably, unpublished “Pencil and pen and ink drawings relating to observations of snow crystal formation, with notes referring to their structure, details of temperature, and dates the observations were made” by Cecilia Glaisher that would be interesting to see in this context.

²¹ Frank (1982) discusses Glaisher, Hellman and Bentley’s overuse of symmetry (p.6), also criticizing Bentley’s methods on the grounds that he would cut out the snowflake print to re-photograph onto a black background (i.e., he says the snowflake outlines are therefore the result of scissor-work), plus notes the flattening effect of the type of lens used.

²² Hellman, G. (1893) *Schneekrystalle: Beobachtungen und Studien*, Berlin: Rudolf Mückenberger.

²³ Scott (1929), p. 199. The entry date was March 30, Easter Sunday.

²⁴ Ibid.

²⁵ Scott (1964), p. 156.

²⁶ Two days later Scott, Wilson, Wright and Taylor were trying to account for the presence of marine organisms in some glacier ice, proposing a theory of former “negative buoyancy”. Ibid, p. 157.

²⁷ After the Discovery expedition, some of Wilson’s drawings were exhibited in London (see note 3) but there is no record of the ice crystal studies being exhibited and, therefore, known by others in the scientific community.

²⁸ King (1996), p. 101, quoting the editor of the book of Antarctic birds, Brian Roberts. Isobel William’s book is notable for equating accuracy in rendition with Ruskin.

²⁹ This model is proposed by great-nephew and author Dr. David Wilson in a presentation made for the Natural History Museum, at: <http://www.youtube.com/watch?v=yaaPjOMLFfM>

³⁰ Discussed briefly in Brady (2011), p.128.

³¹ In a longer essay, this topic would be included in greater detail. Here I can only direct the reader to James Elkins’ 1995 article of the role of images ‘outside’ art, which includes mention of the work of Rudwick (2005, 1976) and François Dagognet’s work on the image, Ferguson on images ‘between’ propositionality and non-propositionality and Hubert Damisch’s work on how images might “think”; ibid, p. 561, notes 58-62.

³² At point of writing I have not visited the SPRI or other collections of Wilson’s work. An important caveat on original manuscripts: some years after Wilson’s death, Oriana organised the destruction of much of their personal correspondence; Seaver’s books (he was allowed access beforehand) have become the main records of that material. An account of their destruction is in the SPRI Oral History Programme interview, “Evelyn Forbes in conversation with Harry [H.R.G] King”, (date not known, viewed January 2012 courtesy of Sue Ferrar, Forbes’ niece).

³³ Ponting (1921), p. 118. A paragraph is spent discussing Wilson’s *modus operandi*, useful for noting how he coped with cold hands.

³⁴ Scott, Ponting and Wright were with Wilson that day, with Wright collecting “some very fine ice crystals”. Unfortunately Scott did not note Wilson’s activities in his brief account, which confirms the Glacier Tongue as the site of the caves. Scott (1964), p. 140.

³⁵ In a letter to Oriana in 1900, Wilson wrote “The whole concentrated beauty of that glorious Norwegian forest at midnight is what I see in the picture of the sparrow-hawk’s nest.” Williams (2008), p.60.

³⁶ John Ruskin (1819-1900), was one of the late nineteenth century’s most prominent art critics and theorists. As one small reflection of Ruskin’s impact on Wilson is his journal entry

for December 11, 1902, while on the Southern Journey: “‘Dog don’t eat dog’ certainly doesn’t hold down here, any more than does Ruskin’s aphorism in *Modern Painters* that ‘a fool always wants to shorten space and time, a wise man wants to lengthen both’. We must be awful fools at that rate, for our one desire is to shorten the space between us and the land. Perhaps Ruskin would agree that we are awful fools to be here at all, though I think if he saw these new mountain ranges he might think perhaps it was worth it.” (Wilson, 1966, p.223).

³⁷ From Ruskin’s 1857 *The Elements of Drawing*, 134-5, quoted in Clark (1967), p. 142.

³⁸ From Ruskin’s 3-volume *The Stones of Venice*, (1851-53), quoted in Clark (1967), p. 143-144. Notably the quote continues that all this and more is only known by perception, and not, as with the newer art, by knowledge, this chimes with Wilson’s known comments about his faith. For an excellent summary of Ruskin’s key tenets, see Clark (1967) p. 133-134

³⁹ A volume of Tennyson’s poetry was carried on the final trip from the Pole. ‘Flower in the crannied wall’ was also quoted in John Fiske’s 1899 book *Through Nature to God*, which Wilson was reading in the Discovery years. Wilson (1966), p. 177. Wilson greatly admired Tennyson’s poem ‘In Memoriam’; in a stanza on nature, Tennyson mentions “Her secret meaning in her deeds” – a parallel with the act of seeing and drawing that Ruskin advocated.

⁴⁰ Roberts (1967), p. 30. He also wrote to her “I can’t believe God has given me such an intense absorbing love for drawing unless it was to be used in some way.” Williams (2008), p.60.

⁴¹ Wilson (2000), p. 30. The drawing is reproduced on page 32.

⁴¹ From an 1896 letter by Edward Wilson to his mother, quoted in Wilson (2000), p. 36.

⁴² Seaver (1948) is a key source, but so also are Wilson’s father and nephew (quoted in Wilson (2000)); Williams (2008) and Wheeler (2001) also provide useful interpretations.

⁴³ Wilson (1966) p. 210.

⁴⁴ Wilson (2000), p. 36.

⁴⁵ Seaver (1948), p.22. Seaver is quoting from letters Wilson wrote to Oriana (probably amongst those destroyed later); see note 32 above.

⁴⁶ Wilson (1966), p. 268.

⁴⁷ Seaver (1948), p.33

⁴⁸ Like Ruskin, Wilson’s instructions to his shipmates in a 1911 winter lecture on drawing to be accurate are misunderstood; most beginners draw from pre-existing notions rather than what they see, and Wilson encourages them to use their eyes, not their minds (a very Ruskinian instruction). Scott (1964), p.163-64, and King (1996), p. 104-105.

⁴⁹ These ideas and more are discussed in relation to literature of the early 19th century in Eric G. Wilson’s 2003 book “The Spiritual History of Ice”; see also Glasberg (2011).

⁵⁰ See note 32 above.

⁵¹ This is ungenerous, to make the point; I do concede that Wilson’s nature studies are also full of wonder, especially those that show birds and animals in motion, for which he has been justly praised.

⁵² Aardse and van Baalen (2007), p. 162.

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